

NASA ADVISORY COUNCIL  
National Aeronautics and Space Administration  
Washington, DC 20546

Dr. Steven W. Squyres, Chairman

March 20, 2012

Mr. Charles F. Bolden, Jr.  
Administrator  
National Aeronautics and Space Administration  
Washington, DC 20546

*Charlie*

Dear Administrator Bolden:

The NASA Advisory Council held a very productive public meeting at NASA Headquarters, Washington, DC, on March 8-9, 2012.

As a result of its deliberations, the Council approved eight recommendations and five findings. They are enclosed for your consideration. If you have any questions or wish to discuss further, please contact me.

Sincerely,



Steven W. Squyres  
Chairman

Enclosures

## NASA Advisory Council Recommendation

### Destination Selection 2012-01-01 (HEOC-01)

**Name of Committee:** Human Exploration and Operations Committee

**Chair of Committee:** Mr. Richard Kohrs

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** Destination Selection

**Recommendation:** The Council recommends selecting a human spaceflight destination ASAP.

**Major Reasons for the Recommendation:** With the approval of a Space Launch System (SLS) Booster, the Orion Spacecraft, and 21st Century Launch Complex planning can now begin on the destination mission. With initial crewed flight in 2021, the first operational flight could occur as early as 2022. Given the budget reality and development time for new hardware and software, (which is estimated to be at least 10 years) now is the time to pick a specific destination in order to focus the NASA, international agencies and contractor teams on a specific destination, such as Mars. In addition, the near and interim steps in order to achieve the ultimate objective should also be defined. We believe that a focused mission with a specific end objective, as has been the case for over 50 years for Human Spaceflight Programs, would also greatly benefit the NASA workforce, current and future domestic and international partners and the public stakeholders.

**Consequences of No Action on the Recommendation:** Without selecting a mission we will delay a human flight to a destination. In addition, it will be difficult for the International Partners to determine where they can contribute to the human exploration program. Further, without a specific Program definition it will become increasingly difficult to get the American public excited about the future of NASA.

## NASA Advisory Council Recommendation

### Specify Mission Objectives 2012-01-02 (HEOC-02)

**Name of Committee:** Human Exploration and Operations Committee

**Chair of Committee:** Mr. Richard Kohrs

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** Specify Mission Objectives

**Recommendation:** The Council recommends developing specific mission objectives for Exploration Mission - 2 (EM-2) that justify the need for a crewed lunar orbit mission.

**Major Reasons for the Recommendation:** The current mission objective for EM-2 is listed as, "Demonstrate crewed flight beyond Low Earth Orbit (LEO)." Crewed flight beyond LEO was demonstrated more than 40 years ago in the Apollo program. NASA needs to show how EM-2 fits within the architecture for future human exploration beyond LEO and ensure that the objectives for a crewed lunar mission are consistent with the cost and risks involved.

**Consequences of No Action on the Recommendation:** NASA leaves itself open to public criticism and loss of Congressional support if it cannot sufficiently justify the need for conducting a mission such as EM-2.

## NASA Advisory Council Recommendation

### International Involvement 2012-01-03 (HEOC-03)

**Name of Committee:** Human Exploration and Operations Committee

**Chair of Committee:** Mr. Richard Kohrs

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** International Involvement

**Recommendation:** The Council recommends identifying an existing International Space Station (ISS) international partner(s) to accelerate expansion of international participation in future deep-space exploration planning. This expanded partnership will bring international resources to exploration and enhance sustainability. For any mission that is selected, additional hardware is needed beyond the Space Launch System (SLS) and Multi-Purpose Crew Vehicle (MPCV) such as a lander, habitat, advanced propulsion systems, etc.

**Major Reasons for the Recommendation:** History has shown that international partnerships have been effective. On ISS the partners have provided additional pressurized elements (i.e., laboratories, nodes and logistics modules), launch vehicles (i.e., Soyuz, Proton, Ariane-5, H2), cargo/crew transfer vehicles (i.e., Soyuz Transport Modified Anthropometric [TMA], Automated Transfer Vehicle [ATV], H2 Transfer Vehicle (HTV)), navigation systems, ground control centers, robotic systems, and training facilities.

**Consequences of No Action on the Recommendation:** Limited U.S. resources will delay exploration of the solar system. Additionally, strength of international treaties will benefit sustainability of exploration programs.

## NASA Advisory Council Recommendation

### Creation of Subcommittee to NASA Advisory Council Human Exploration and Operations Committee 2012-01-04 (HEOC-04)

**Name of Committee:** Human Exploration and Operations Committee

**Chair of Committee:** Mr. Richard Kohrs

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** Creation of Subcommittee to NASA Advisory Council Human Exploration and Operations Committee

**Recommendation:** The Council recommends the creation of a subcommittee of the Human Exploration and Operations (HEO) Committee that advises NASA on the research and educational needs that are required to support a plan for the long-range human exploration of space. The subcommittee should include a breadth of perspectives that encompass research and higher educational needs, not representation of specific disciplines.

**Major Reasons for the Recommendation:** Efficient, coordinated and cost-effective advancement toward long-range space flight requires effective advance planning of an integrated research program that addresses both the physical and life sciences. A group of individuals who understand the Space Life and Physical Sciences Research programs would provide the strategic guidance that is required to achieve these goals, and would build strong supportive links with the academic and research communities that will be required to support these goals.

**Consequences of No Action on the Recommendation:** NASA and the Human Exploration and Operations Mission Directorate (HEOMD) will lack the relationships with the academic community that are necessary to assure effective coordination of research with mission goals, and engagement with the educational community that shapes the scientists of tomorrow.

## NASA Advisory Council Recommendation

### Recovering the Planetary Exploration Program 2012-01-05 (SC-01)

**Name of Committee:** Science Committee

**Chair of Committee:** Dr. Wesley Huntress (*Dr. Alan Boss, Acting Chair*)

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** Recovering the Planetary Exploration Program

**Recommendation:** The Council recommends that NASA seek restoration of funds in its FY14 budget proposal to repair the damage done to the Nation's robotic planetary exploration program within the context, but not at the expense of a balanced science program that has already absorbed numerous funding reductions in recent years. The Council concurs with the Science Mission Directorate's (SMD's) initiative to reformulate the Mars Exploration Program for missions in 2018-2020 in partnership with human space flight, technology development, and potential international partners, pending any Congressional direction and under the condition that the plan must be consistent with Decadal Survey recommendations.

**Major Reasons for the Recommendation:** The FY13 budget proposal contains a precipitous drop in funding for the Planetary Science Division and sets the program on a decline in the out years reducing the flight rate for Discovery and New Frontiers missions, terminating operating missions before their prime, and removing funding for the 2016 and 2018 Mars missions planned in collaboration with the European Space Agency (ESA). The funds remaining do not allow for a Mars mission in 2016 but may be sufficient for a medium-class mission in 2018 or 2020.

**Consequences of No Action on the Recommendation:** The current funding profile for the Nation's robotic planetary exploration program will sacrifice critical capabilities and our leadership to other space-faring nations as they pursue capabilities and goals abandoned by the United States.

## NASA Advisory Council Recommendation

### Enhanced Cooperation in Planetary Protection 2012-01-06 (SC-02)

**Name of Committee:** Science Committee

**Chair of Committee:** Dr. Wesley Huntress (*Dr. Alan Boss, Acting Chair*)

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** Enhanced Cooperation in Planetary Protection

**Recommendation:** The Council recommends that NASA and the European Space Agency (ESA) renew the Letter of Agreement and further explore mechanisms for more closely coordinating their required planetary protection activities, including technology-development, with the goal of achieving high degrees of coordination and cooperative technology development for planetary protection to ensure most efficient use of available resources. Further, the Council recommends that the Planetary Protection Working Group (PPWG-ESA) and Planetary Protection Subcommittee (PPS-NASA) continue joint activities in planetary protection, including the regular exchange of meeting minutes and holding joint advisory meetings approximately every 2 years.

**Major Reasons for the Recommendation:** The 2007 ESA-NASA Letter of Agreement provides for cooperation on planetary protection and is the basis for effectively coordinating joint development of planetary protection technologies. However, the current Letter of Agreement expires December 31, 2013. Close cooperation on planetary protection is important to the function of both NASA and ESA, particularly in the context of increasing participation in joint/international missions.

**Consequences of No Action on the Recommendation:** The legal authority for cooperation in this important area will expire.

## NASA Advisory Council Recommendation

### Mars Science Laboratory (MSL) Planetary Protection Lessons Learned Report 2012-01-07 (SC-03)

**Name of Committee:** Science Committee

**Chair of Committee:** Dr. Wesley Huntress (*Dr. Alan Boss, Acting Chair*)

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Recommendation:** Mars Science Laboratory (MSL) Planetary Protection Lessons Learned Report

**Recommendation:** The Council recommends the preparation of an extensive “lessons-learned” report be completed while the MSL Planetary Protection team remains intact and available for preparation of the report. The report should include:

1. Issues with spacecraft materials and contamination control that may affect measurements made either *in situ* or after return.
2. Key elements of a bioburden accounting software package that can be developed jointly for use in the Mars Sample Return (MSR) campaign.
3. Publication of the Adenosine Triphosphate (ATP) assay as related to the NASA Standard Assay, to facilitate adoption of this assay for bioburden accounting on MSR elements.
4. Research needed to improve the assessment of proposed landing sites in the context of concerns for liberation of fluids from hydrated or frozen ground in the presence of a Radioisotope Power System.

**Major Reasons for the Recommendation:** Planetary protection engages numerous competing needs, including science and engineering considerations, general contamination control, materials compatibility with bioburden/organic reduction, etc. Plans for future Mars Sample Return missions will rely on heritage hardware, held to higher bio-cleanliness standard than any mission since Viking, for both planetary protection and science. Viking planetary protection “lessons-learned” report was a valuable resource for transmitting knowledge and practice to subsequent projects. It is important that the transmission of lessons-learned from ongoing missions, especially MSL, to developers of the MSR campaign be accomplished.

**Consequences of No Action on the Recommendation:** NASA’s withdrawal from the Mars Sample Return campaign as previously structured and formulated for initiation during the 2018 Mars launch opportunity makes the recording of lessons from the MSL project experience all the more important. The now potentially long hiatus in U.S. Mars surface operations for sample return threatens an especially severe loss of accumulated knowledge and experience.

## NASA Advisory Council Recommendation

### NASA IT Technologies Partnerships with Other Federal Agencies and Public/Private Opportunities 2012-01-08 (ITIC-01)

**Name of Committee:** Information Technology (IT) Infrastructure Committee

**Chair of Committee:** Dr. Larry Smarr

**Date of Council Public Deliberation:** March 9, 2012

**Short Title of Recommendation:** NASA IT Technologies Partnerships with Other Federal Agencies and Public/Private Partnerships

**Recommendation:** To enable NASA to gain experience on emerging leading-edge IT technologies such as:

- Data-Intensive Cyberinfrastructure,
- 100 Gbps Networking,
- Graphics Processing Unit (GPU) Clusters, and
- Hybrid High Performance Computing (HPC) Architectures,

the Council recommends that NASA aggressively pursue partnerships with other Federal agencies, specifically the National Science Foundation (NSF) and Department of Energy (DOE), as well as public/private opportunities. We believe joint agency program calls for end users to develop innovative applications will help keep NASA at the leading edge of capabilities and enable training of NASA staff to support NASA researchers as these technologies become mainstream.

**Major Reasons for the Recommendation:** NASA has fallen behind the leading edge, compared to other Federal agencies and international centers, in key emerging information and networking technologies. In a budget constrained fiscal environment, it is unlikely that NASA will be able to catch up by internal efforts. Partnering, as was historically done in High Performance Computing Center (HPCC), seems an attractive option.

**Consequences of No Action on the Recommendation:** Within a few more years, the gap between NASA internally driven efforts and the U.S. and global best-of-breed will become a gap too large to bridge. This will severely undercut NASA's ability to make progress on a number of critical application arenas.

**NASA Advisory Council Finding**  
**The President's FY13 Budget Proposal**

**Name of Committee:** Science Committee

**Chair of Committee:** Dr. Wesley Huntress (*Dr. Alan Boss, Acting Chair*)

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Finding:** The President's FY13 Budget Proposal

**Finding:**

- NASA's top line in the Administration's FY13 budget proposal is nearly the same as in FY12 (down \$58.6M or -0.3%). The FY13 budget establishes James Webb Space Telescope (JWST) as an Agency priority and provides in full the resources identified in last year's re-plan to complete JWST and launch it in 2018. Earth Science is also increased in FY13 and the out-years.
- The overall Science Mission Directorate (SMD) budget has taken a decrease of \$162.5M (-3.3%) in FY13 and is flat-lined over the 5-year run-out. This funding situation results in a proportionally larger (11-fold) decrease for SMD compared to the entire Agency. Many recommendations in the recent National Research Council (NRC) Decadal Surveys will not be accomplished, particularly Flagship-class missions in Planetary (Mars, Outer Planets) and Astrophysics (Wide Field InfraRed Survey Telescope - WFIRST), and this situation may adversely impact the Heliophysics Decadal Survey which will be released shortly.
- The Planetary program has been singled out for a massive reduction, by 21% in FY13 with further reductions in the out-years. The flight rates of the highest priority programs, Discovery and New Frontiers, will be drastically reduced and there are insufficient funds in the out-years to operate the expected fleet of flight missions. The Mars Exploration Program will take the brunt of the reductions with the elimination of the 2016/2018 joint Mars missions with the European Space Agency (ESA). The Outer Planets program is reduced to study concepts.

## NASA Advisory Council Finding

### Green Aviation

**Name of Committee:** Aeronautics Committee

**Chair of Committee:** Ms. Marion Blakey

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Finding:** Green Aviation

**Finding:** The Council fully supports the research NASA's aeronautics program is conducting in the area of Green Aviation. The Council understands the challenges related to noise reduction and reduction in emissions (CO<sub>2</sub>, NO<sub>x</sub>, and other harmful particulates) and compliments the Aeronautics Research Mission Directorate's (ARMD's) approach to address the challenges from a system wide perspective that considers both vehicles and operations. The Council is encouraged by the efforts to capture the results of systems analyses and trade studies/sensitivity analysis. Understanding the market space and economics are key to identifying the correct technology barriers that need to be addressed. To help demonstrate and test potentially high risk technologies that are developed, it is important to establish strong collaborative partnerships with other government agencies and industry. NASA Aeronautics is continuing with its portfolio review and assessment, which the Council fully supports and looks forward to the results as the assessment progresses, particularly in relation to investments in green aviation research. Additionally, the Council was briefed on NASA's research on Hybrid Wing Bodies. Given their efficiency and noise reduction potential, the Council sees any future N+2 research in this area as promising.

## **NASA Advisory Council Finding**

### **Interagency Coordination and Collaboration in Research on Use of Alternative Fuels for Aviation**

**Name of Committee:** Aeronautics Committee

**Chair of Committee:** Ms. Marion Blakey

**Date of Council Public Deliberation:** March 8, 2012

**Short Title of Finding:** Interagency Coordination and Collaboration in  
Research on Use of Alternative Fuels for Aviation

**Finding:** The Council is very pleased to see NASA Aeronautics Research Mission Directorate's (ARMD's) proactive leadership to help form strong coordination and collaboration in research between NASA and other government agencies concerning the use of alternative fuels for aviation and hopes that coordination and collaboration will continue. The Council believes the coordination effort to date is re-affirming NASA's role in conducting research to characterize alternative fuels including emissions characterization and to develop fuel-flexible combustor technologies.

**NASA Advisory Council Finding**

**More Productive NASA IT Infrastructure  
Through Frugal Innovation and Agile Development**

**Name of Committee:** Information Technology (IT) Infrastructure Committee

**Chair of Committee:** Dr. Larry Smarr

**Date of Council Public Deliberation:** March 9, 2012

**Short Title of Finding:** More Productive NASA IT Infrastructure Through Frugal Innovation and Agile Development

**Finding:** To enable new scientific discoveries, in a fiscally constrained environment, NASA must develop more productive IT infrastructure through “frugal innovation” and “agile development”:

- Easy to use as “flickr”
- Elastic to demand
- Continuous improvement
- More capacity for fixed investment
- Adaptable to changing requirements of multiple missions
- Built-in security that doesn’t hinder deployment

## **NASA Advisory Council Finding**

### **Science Mission Directorate Data**

**Name of Committee:** Information Technology (IT) Infrastructure Committee

**Chair of Committee:** Dr. Larry Smarr

**Date of Council Public Deliberation:** March 9, 2012

**Short Title of Finding:** Science Mission Directorate Data

**Finding:** Science Mission Directorate (SMD) data resides in highly distributed servers:

- Many data storage and analysis sites are outside NASA Centers
- Access to entire research community essential
  - Over half science publications are from using data archives
  - Secondary storage needed in cloud with high bandwidth and user portal
- Education and public outreach of data rapidly expanding
  - Images for public relations
  - Apps for smart phones
  - Crowdsourcing